REVIEW OF FORMALDEHYDE FUMIGATION.

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It is just about four years since I had the pleasure of reading a paper before this Section, on the Importance of Standard Methods for Testing Disinfectants, which resulted in the appointment of a Standardization Committee by the Council of this Association, the work of which has borne, as you all well know, such excellent fruits.

In taking a bird's-eye view of the various methods used in this country as well as abroad for room disinfection by means of formaldehyde, as a preventive or after cases of communicable diseases, the situation reveals conditions almost as chaotic as those of the testing of disinfectants did in 1909. Many investigators, however, have sounded the note of warning years ago, particularly Rickards, in a paper read before the Section of Medical Health Office, in 1908 and Holm and Gardner, in an article published in the *Journal of Infectious Diseases*, 1910. It is not within the scope of this paper to enter into the merits of formaldehyde disinfection in general or to discuss after which diseases it should be practiced, but there is no doubt that the lack of uniform methods of application under fixed conditions is responsible in a very great measure for the discredit into which disinfection has fallen with a large percentage of professional men.

The chemical and physical characteristics qualify formaldehyde as the most suitable agent today for disinfecting rooms and objects contained therein and a number of thoroughly scientific experiments as well as actual experience in practice prove that most reliable results can be obtained.

The respective literature on the subject offers an enormous field of suggestions, concerning methods and apparatus for room disinfection by means of formaldehyde and considering the great importance of the question, it may be of interest to review briefly the most common ones.

1. GENERATION OF FORMALDEHYDE GAS BY OXYDATION OF METHYL ALCOHOL.

This is probably the oldest method of production and consists of passing methyl alcohol vapor over heated platinum black or platinized asbestos by means of suitable contrivances. Their number counts legion and although they do not interest us from a large scale viewpoint on account of economy and efficiency, they still enjoy considerable application in homes, offices, etc., for deodorizing purposes and for medicinal uses to disseminate essen-

tial oils, menthol, thymol, etc. The chemical process of these lamps still forms the basis for the process of manufacture of formalin commercially today.

2. Generation of Formaldehyde Gas-Water Vapor Mixtures by Means of Apparatus.

This method is based on the principle of vaporizing the gas from an aqueous solution by means of external heat. The oldest representative type is the Trillat autoclave which, however, has almost gone out of use. In this country a certain type of regenerators still enjoys a great reputation on account of its efficiency, simplicity, economy, and safety from explosion. The formaldehyde solution drops by means of a needle-valve into a heated concave copper chamber, where it is immediately broken up into formaldehyde gas and water-vapor. It is well known that if formaldehyde solution passes over a surface heated above the degree of Depolymerization, say to about 200° C in a slow, steady stream, absolutely no polymerization can take place. In Germany the so-called "Glykoformalmethod" where glycerine is added to the formaldehyde solution, and other similar methods have been considerably used. The object seems to be to produce a spray or mist whereby a more uniform distribution of formaldehyde and water vapor is obtained in the space. The best of these apparatus have the great advantage that the yield of formaldehyde gas is very high and that they can be operated from the outside of the room to be disinfected and their action thereby controlled.

3. Formalin Sheet Spraying Method.

This method is based on the evaporation of a formalin solution from a sheet saturated with same. From a chemical standpoint I should doubt if this is a very economical mode of application, in as much as formalin by slow evaporation will polymerize a large percentage of formaldehyde into paraform.

4. Generation of Formaldehyde Gas and Water Vapor Mixtures without Special Apparatus.

The main characteristics of this method consists in the fact that no direct fuel supply is necessary to produce formaldehyde gas and water vapor, but the heat is supplied by chemical reaction between the formaldehyde solution and the other reagent, which is generally an oxydizer. The best known of them all is the formalin-permanganate method which is too well known to require further description except that various experimenters have adopted different proportions of permanganate and formalin in view of obtaining the highest percentage of gas. Evans recommends practically 4 to 10. Base and McClintic of the Hygienic Laboratory 5 to 10, The Bureau of Animal Industry 8 to 10, Hill & Roberts, Minnesota State Board of Health Laboratories, 7 to 10 per 1000 cubic feet. A prominent municipal Health officer told me about a year ago that he found the formaldehyde

permanganate method to give, even in dosage of 16 ounces of formaldehyde and 8 ounces of permanganate per thousand cubic feet, very unsatisfactory results, and that furthermore, the inspectors refused to use that method, complaining that their health is being affected through their fumigation work, because the reaction is so quick after sealing that they cannot leave the room quick enough and the formaldehyde vapors which they are compelled to inhale are very detrimental to their general well-being in the long run. He says they are compelled to consider the comfort of the inspectors and I thought it was a very important factor. Even from an economical viewpoint, this Municipal Health Officer assures me that although the formaldehyde-permanganate is cheap in cost of material, the process of disinfection by that method is more expensive, because they have to use a very large pail in which they place the ingredients, and the inspector has to call back for that pail after the premises are opened up, or abandon same, which in either case is a waste of labor and therefore an increased cost over the use of solidified preparations. Home and Gardner, in their very able investigation referred to at the beginning of the paper, prove that the lower the ratio between formaldehyde and permanganate the higher the loss in available formaldehyde gas and in order to insure abundance of moisture a permanganate diluted formalin can be used to great advantage, one of the best formulas being that of Hill and Roberts, namely:

Formaldehyde	11	parts by	volume
Permanganate	11	" "	weight
Water	9	" "	volume

Abroad, various investigators have experimented to replace permanganate with other oxydizing agents, such as barium, or strontiumperoxide, hypoclorides, etc., using paraform instead of formalin or formaldehyde source but they show less efficient and about doubly more expensive. More satisfactory results, however, were obtained by replacing a small percentage of permanganate with another oxydizer and the greatest hope for improvement over the present method comes from this quarter.

In spite of the great advantages in efficiency and simplicity, the question of economy and the discomfort and harm caused to those who have to work with it regularly, prevent to secure to the permanganate-formalin method the popularity it would otherwise deserve or enjoy.

There is still another group of Formaldehyde generators to be mentioned, the so-called commercial fumigators, which produce their gas either from solidified formaldehyde or by vaporizing paraform in various ways. Most of the manufacturers, however, fail to state the proper quantity required per 1,000 cubic feet and in most cases where statements are made they are exaggerated and unreliable, otherwise these so-called candles would enjoy great popularity on account of their simplicity. Holm says: "It is a curious

fact that the various proprietary manufacturers have in their possession testimonials and recommendations from numerous bacteriologists showing the efficiency of their products, and many of these bacteriologists are peculiarly men of national or international reputation. But the methods of investigation and the nature of the culture as well as the conditions of exposure vary so enormously that such testimonials are practically worthless. I know of a case where a prominent board of health using one of the best known brands is compelled to use the candle in four times the strength recommended by the manufacturer on the label."

Another point which needs mention is the want of accuracy in control tests which is most ably discussed by Dr. Hüne in "Desinfektion," Volumn 4, No. 1.

Rickards, after collecting his statistical information regarding disinfection as carried on in the larger cities of the United States, says: "The present situation is intolerable viewed from a scientific standpoint. If disinfection is of value in any case then it should be done in an efficient manner; a manner proved by exhaustive work to be reliable. If disinfection in general is not of value and can be proved to be of little or no value in any given disease, then disinfection in that case should be abandoned and trouble and expense thus saved."

When we consider these words, I think it is high time for this Section to take up this important question officially by asking the Council to appoint a standardization committee to investigate formaldehyde room disinfection.